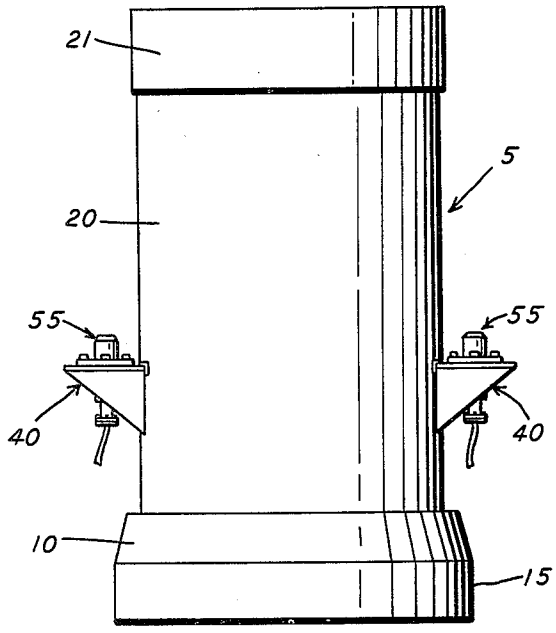
Oct. 21, 1952 D. H. RANKIN ET AL 2,614,312

METHOD OF MOLDING TUBULAR CONCRETE ARTICLES

Filed June 10, 1946 2 SHEETS—SHEET 1

Fig. 1



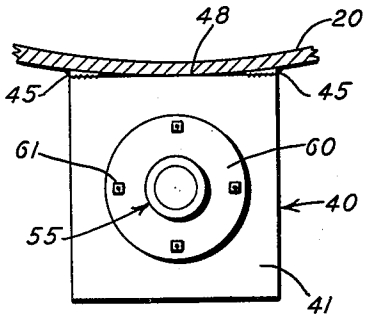


Fig. 2

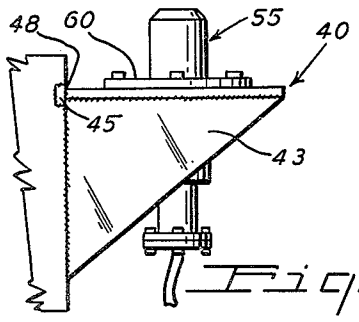


Fig. 4

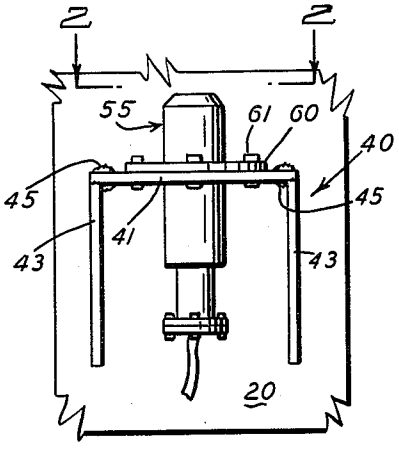


Fig. 3

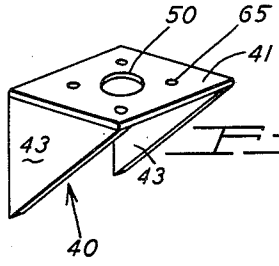


Fig. 5

INVENTOR.
Donald H. Rankin
Charles E. Little
By Mason & Graham.
Attys

Oct. 21, 1952 D. H. RANKIN ET AL 2,614,312

METHOD OF MOLDING TUBULAR CONCRETE ARTICLES

Filed June 10, 1946 2 SHEETS—SHEET 2

Fig. 6

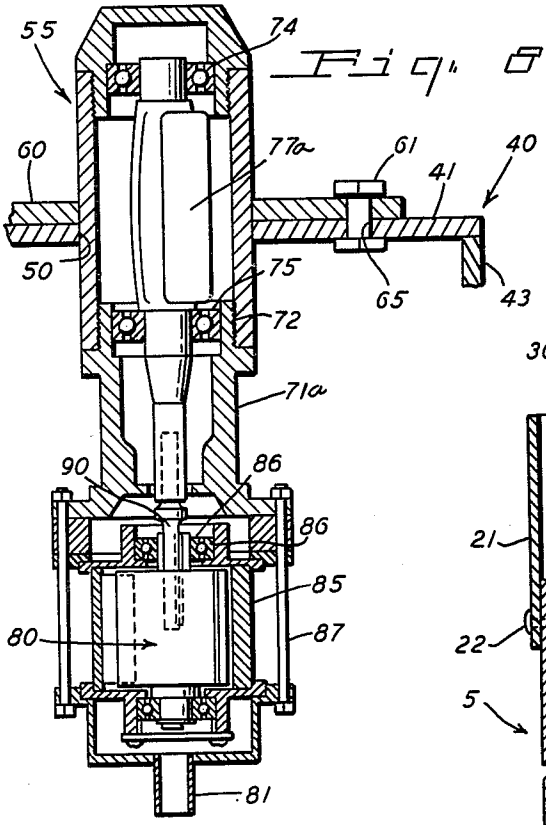


Fig. 7

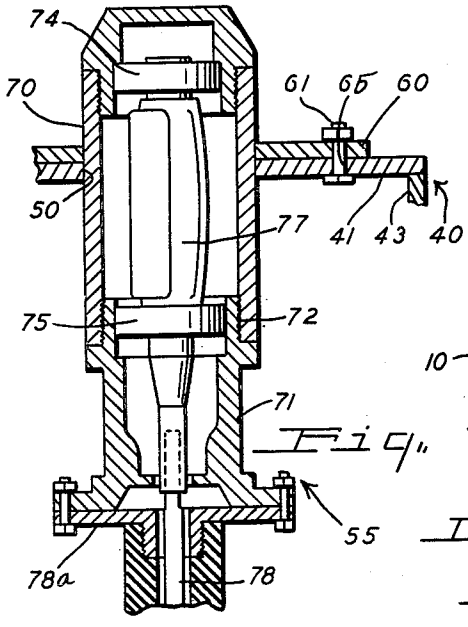
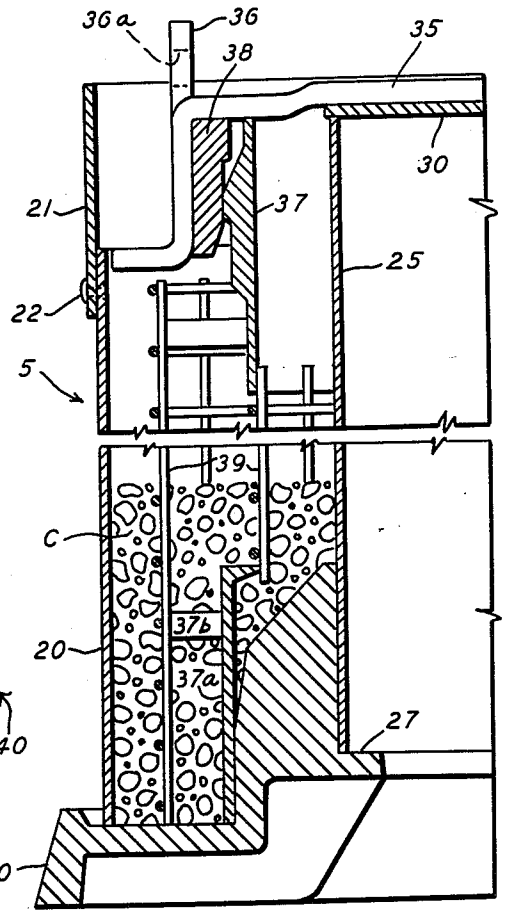


Fig. 6



INVENTOR.

Donald H. Rankin
Charles E. Little
By Mason & Graham
Attys.

Patented Oct. 21, 1952 2,614,312

UNITED STATES PATENT OFFICE

2,614,312

METHOD OF MOLDING TUBULAR CONCRETE ARTICLES

Donald H. Rankin, Long Beach, and Charles E. Little, North Hollywood, Calif., assignors to American Pipe and Construction Co., South Gate, Calif., a corporation of Delaware

Application June 10, 1946, Serial No. 675,702

1 Claim. (Cl. 25—155)

1

Our present invention has to do with methods of forming concrete structures and, while not specifically limited to such use, is particularly well adapted for use in forming such concrete structures or articles as reinforced concrete pipe.

As is well known, in the formation of concrete pipe it is desirable that the body of the concrete possess as few voids as possible—that is, the aim is to obtain maximum density not only for purposes of strength and long life but also in order that the pipe may have minimum porosity. Many of such voids are usually caused by air pockets formed during the mixing and pouring, from which the air is not released before final setting of the concrete. Various means of treating the concrete in the form have been proposed with the aim of settling the mix and eliminating those pockets, but the results, at best, have not been entirely satisfactory.

It is therefore an object of our invention to provide a novel method of treating cement mixtures before they set to eliminate therefrom substantially all air pockets and voids and to thereby provide a finished product which has maximum density, life and strength.

More specifically it is one of our aims to provide a method of subjecting cement mixtures to adequate vibration while in the wet stage.

A further specific object of our invention is to provide a method of vibrating a concrete form and its contents in such a way that the antinodes of vibration become so distributed throughout the form and mix that when consolidation of the mix is complete all parts have been subjected to maximum vibration.

Still further objects and corresponding advantages will appear from the following description of a presently preferred adaptation and practice of the invention, which description is intended merely for explanatory purposes and not as limitative upon the broader scope of the invention as defined by the appended claim.

In the ensuing description we shall refer to the accompanying drawings, in which:

Fig. 1 is a side elevation of a mold or form for forming concrete pipe, with our novel vibrating means secured thereto;

Fig. 2 is a view taken on line 2—2 of Fig. 3;

Fig. 3 is an enlarged front elevation of one of the vibratory mounting means;

Fig. 4 is an enlarged side elevation of one of the vibratory mounting means;

Fig. 5 is a view of one of the vibratory mounting means;

Fig. 6 is an enlarged fragmentary section of the form or mold shown in Fig. 1;

2

Fig. 7 is an enlarged medial longitudinal section of a vibratory device used in carrying out our invention; and

Fig. 8 is an enlarged medial longitudinal view of a variational form of vibrator.

Agitation or tamping of the mix are the procedures customarily followed in attempting to eliminate voids, but this has not been entirely successful and requires considerable time and expense.

It has also been proposed to vibrate the mold in attempting to eliminate the voids and many attempts in this direction have been made but have not proved to be satisfactory or practical.

We have discovered that the vibration can be rendered highly successful and productive of unexpectedly efficient results by producing multi-directional vibration of the mold at a very high frequency—preferably varying the frequency within the high ranges—while the mold is being charged with the wet mix. We find that by this method the antinodes of vibration become so distributed throughout the mold and mix that, when consolidation of the mix is complete, all parts of the mold and mix will have been subjected to maximum and adequate vibration. By virtue of the high frequency (the lower limit of which we find to be productive of the desired results being of the order of 8,000 per minute) the amplitude of the vibratory movements is such that the antinodes are relatively closely spaced. Then the varying of the frequency so changes the antinodes as to better distribute them throughout the mix, which result is further enhanced by the changes in characteristics of the mix caused by the gradual filling of the mold and consolidation of the mix. While we find that operation of the vibrating element at substantially constant frequency of the order of 8,000 per minute or above, is productive of satisfactory results, by operating the vibrator means at varying frequencies the efficiency is materially increased.

The type of vibrator which we find ideal is one having a body or housing rigidly secured to the mold periphery and having an unbalanced rotor journalled in the housing and driven at a speed of at least 8,000 R. P. M. Preferably the axis of the rotor should be slightly radially spaced from the mold periphery and should be parallel with the longitudinal axis of the mold. We find also that, for best results, the vibrator housing should be secured to the mold at a point about midway of the lower half of the mold periphery.

We also find that while a single vibrator so

secured to the mold will suffice for efficient results, we are able to improve the efficiency to an unexpectedly great extent by employing two vibrators rigidly secured to the mold periphery at circumferentially spaced points, preferably at diametrically opposite points, and driven at relatively different speeds, preferably relatively varying the speeds in opposite senses.

Referring now to the particular adaptation of our invention illustrated in the drawings, we show at 5 a cylindrical mold or form, resting at its bottom end upon a base plate 10, which base is, in turn, mounted upon a suitable foundation 15. For a better understanding of the mold structure see Fig. 6.

While our invention is not limited to use on any particular form or mold, we show in Fig. 6 a fragmentary section of a mold which we are presently using and find it to be highly efficient because its parts are so arranged that the mold and its carried charge of cement mixture more or less vibrate as a unit.

Referring now to Fig. 6, the numeral 20 denotes the outer shell of the mold, having a cylindrical extension 21 at its top, the extension being secured to the shell 20 as by rivets 22. The inner shell is denoted by the numeral 25 and rests at its bottom end on an annular shoulder 27 provided by the base 10. The inner shell has a cover plate 30 secured to its top end as by welding. A transverse yoke or bar 35 is preferably welded to the cover plate 30 and is bent downwardly and thence outwardly at its ends to abut the inner surface of the outer shell so as to maintain concentricity between the inner and outer shells and so as to provide some lateral rigidity to the structure in addition to that provided through the box and contents. The yoke has lifting handles 36 presenting a hole 36*a* to receive a lifting hook. In practice, a joint ring 37 may be supported concentrically between the inner and outer shells to become embedded in the concrete, being suspended from the yoke as by lugs 38. A ring of reinforcing steel, denoted by the numeral 39, rests at its bottom on the base, being held centered at its upper end by engagement with the joint ring. The mold is shown partly filled with a wet cement mixture C. A second joint ring 37*a* is laterally supported by a block 37*b* fixed to the reinforcing ring.

Thus it will be observed that the annular space between the inner and outer shells is open at its top so that the wet cement mix M may be poured therein, and, through the metal of the pipe, the inner shell, the yoke, the reinforcing steel and the charge of cement mixture, the entire mold appears to vibrate substantially as a unit.

Our novel means for effecting vibration of the mold will now be described, reference being made particularly to Figs. 1–5 and 7. As best shown in Fig. 1, we provided at each side of the mold a metal bracket 40, each of which has a shelf portion 41 and legs 43. Since the vibratory stresses are considerable, we prefer to provide, for each bracket, a pair of bosses 45 welded to or formed integral with the periphery of the mold slightly below the upper half of the outer shell. Then the back edge 48 of each shelf is welded to the outer shell and to the bosses while the back edges of the legs are likewise welded to the shell so that the entire bracket is rigid with the shell, the legs being in turn welded to the shelf. Each shelf has a central opening 50 within which a vibrator, generally denoted 55, is mounted, the vibrator having an attaching flange 60 rigidly secured to the shelf by bolts 61 which pass through holes in the flange registering with holes 65 in the shelf.

We have found a vibrator of the type employing an unbalanced rotor, rotating about an axis parallel with the longitudinal axis of the mold, to be highly preferable and efficient, particularly when mounted on a mold as contemplated by our invention. This vibrator will now be described, reference being made particularly to Fig. 7.

The vibrator has a cylindrical casing 70 having a lower end extension 71 threaded thereto at 72. Bearing members 74, 75 are mounted concentrically in the casing for rotatably supporting an unbalanced rotor 77 driven from a suitable remote source of power as by a flexible shaft 78 connected to the flanged lower end of the casing by flange 78*a*. The attaching flange 60 is disposed medially of the casing 70 and is rigidly secured to the shelf by bolts 61.

In Fig. 8 we show another form of vibrator which we have found to be suitable and which is like the vibrator just described except that, in lieu of being driven from a remote source of power through a flexible shaft, it has a conventional air motor 80 carried by a bottom extension 85 of the casing portion 71*a*, which motor is operatively connected to the unbalanced rotor 77*a* by shaft 90 journalled in bearing 86, the air motor being supplied with air under pressure from a remotely located compressor through an air line 81. The casing extension 35 is suspended from casing portion 71*a* by bolts 87.

In operation, operation of the vibrator or vibrators is commenced as introduction of the wet mix into the mold is commenced and is continued until about five minutes after the mold is filled, assuming that the job of filling the mold progresses at normal speed without such delay between introduction of batches as to permit of setting of a previously deposited batch before introduction of another batch.

We claim:

The method of forming tubular concrete articles in an annular mold which includes introducing a wet concrete mix into the mold and vibrating the mold by generating rotary vibrations in excess of 8000 cycles per minute simultaneously about spaced axes extending parallel to the longitudinal axis of the mold, the vibrations generated at one point being substantially different in frequency than the vibrations generated at another point, and communicating the generated vibrations to the mold through means rigidly connected to the mold.

DONALD H. RANKIN.
CHARLES E. LITTLE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,787,449	Jackson	Jan. 6, 1931
1,825,117	Hudson	Sept. 29, 1931
1,867,837	Jackson	July 19, 1932
1,868,169	Jackson	July 19, 1932
1,979,548	Horsch	Nov. 6, 1934
2,054,253	Horsch	Sept. 15, 1936
2,091,385	Trickey	Aug. 31, 1937
2,309,033	Baily	Jan. 19, 1943
2,311,358	Baily	Feb. 16, 1943
2,398,455	Unger	Apr. 16, 1946